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D. MURRAY & H. HORN-JOHNSON

ELLIOT LAKE LABORATORY

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GUNNAR MAIN TAILINGS: FIELD OVSERVATIONS

by

David Murray* and Hart Horn-Johnson**

SUMMARY

The Gunnar uranium mill tailings near Uranium City, Saskatchewan was the site of a number of vegetation experiments. The progress of some of these studies was assessed by the authors in August of 1982 to obtain a perspective for future work. The effects of quick and slow release fertilizer, grass seeding and hummock transplanting were evaluated and are reported. Slow release fertilizer continued to show its effect while seedlings and transplants indicated problems due to drought and blowing sands from the unstable surface. Several suggestions for vegetating the entire tailings are being discussed.

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* Agronomist, Elliot Lake Laboratory, CANMET, Energy, Mines and Resources Canada, Elliot Lake, Ontario. ** Saskatchewan Environment, Regina, Saskatchewan.

OBSERVATIONS AND DISCUSSION

In the summer of 1981 Margaret Kalin of the Institute of Environmental Studies (U. of T.) performed a number of vegetation experiments on the main area of the Gunnar uranium mill tailings, located on the Crackingstone Peninsula near Uranium City, Saskatchewan. These experiments were carried out under contract to the Mines Waste Research Secretariat of the Saskatchewan Department of the Environment, as a first step in the ultimate mitigation of the large windblown portion of the tailings. The experiments were reported in detail in Kalin's Environmental Conditions of Two Abandoned Uranium Mill Tailings Sites in Northern Saskatchewan (1982). Being part of a larger effort in characterizing the tailings and existing vegetation, the experiments covered fertilization, seeding/fertilization, and transplant trials.

On October 8, 1981, and on August 19, 1982, the writers visited the Gunnar Main Tailings, partly to ascertain the status of the 1981 experiments. In 1982, they jointly made and recorded their observations concerning the condition of the test plots and the surrounding vegetation. The time spent on the tailings was rather limited, permitting only the conduct of a visual survey. The review of the experimental work was also hampered, especially in the replicate treatment areas, by the absence or obliteration of identification tags due to weather conditions. Nevertheless, useful information was obtained, as presented in the following appendix.

One discernible difference in 1981-1982 conditions on the tailings was the fact that, in 1982, both tailings materials and vegetation appeared to be drier than in 1981. In the windblown portion of the tailings dry sand

extended to approximately three inches from the surface in 1982, where it extended about one inch in 1981. Likewise, the colouring of tailings vegetation appeared to be much less vivid in 1982 than in 1981. These appearances seem to contradict data on precipitation comparisons. More rain fell in 1982. These comparisons are not particularly helpful, however, without additional comparative information on evapotranspiration. Moreover, the 1982 visit was preceded by frost four days earlier.

The review by Murray and Horn-Johnson covered the three major aspects of the reported experimental work: fertilization plots, replicate treatment areas, and transplant locations. The enhancement of native vegetation, and to a lesser extent of seeded introduced species, by the use of slow release nutrient in the test plots, provided the most lasting evidence of the 1981 experiments on the Gunnar Main Tailings.

It is the conclusion of the observers that the enhancement of vegetation and possible surface stabilization gain some encouragement from the 1981 experiments as a whole. The larger site supports a strong and varied native population of vegetation in the moister, lower areas and in the portions not subject to blowing tailings materials. The response of this native vegetation to fertilizer shows that increased productivity, greater ground cover, and enhanced seed dispersal can occur with proper management.

When the tailings were visited by the observers in the fall of 1981, most fertilization plots showed response to nutrient provision by means of both fast and slow release. The same was true for some of the replicate treatment

areas, though most visibly so for the native growth contained within these plots. The 1982 examination showed that continued growth response occurred mainly where slow release fertilizer had been applied. This indicates that leaching of nutrients is a major factor affecting growth enhancement on the Gunnar Main Tailings.

Replicate areas R2-A and B provided the best visual evidence in the fall of 1981 of seed establishment and vegetative production in conjunction with fertilization. Some plots had produced well in the summer of 1981, only to catch heavy loads of windblown tailings. This trend was found to be further aggravated in 1982. The greater the exposure of new vegetation to windblown materials, the greater the mortality. Hence, seed establishment was clearly a partial function of surface stability. Moreover, the continued survival in 1982 of some seeded grasses, despite windblown tailings accumulation, indicates that adequate moisture sources are available in the coarser tailings sands.

The transplants of foxtail hummocks had not been accompanied by fertilizer application in the 1981 experiments. A cursory examination of the sixty transplants in the fall of 1981 showed that all hummocks had survived the initial transplant trauma. The finding in 1982 was that the mortality was quite high. Surface instability in the areas surrounding the transplants likely contributed significantly to low survival. Moisture availability, or the relative lack of it, may have been another factor. In combination with Kalin's findings concerning foxtail barley seed germination and establishment in gunnar tailings materials (laboratory testing), surface instability at Gunnar Main holds out relatively little hope for the successful utilization of the transplant method in an endeavour to revegetate the windblown tailings.

It is clear that surface stabilization of the large windlbown portion of the Gunnar Main Tailings is a prerequisite for the establishment and production of plant life in this bare area. A variety of possible stabilization measures may be envisaged.

Perhaps the simplest method would be the application of mine waste rip-rap. This material could be obtained from the existing wastepiles of the old mine. Some organic material (till) may be available in the area of the old air strip for surface application. Seeding and fertilization could be carried out if quick results are desired. Otherwise, with or without the use of fertilizer, natural revegetation can be expected to take place over several years. In view of the isolated location of the Gunnar tailings, however, the procurement and mobilization of heavy equipment would be somewhat difficult and costly. Still, the mine waste rip-rap application method constitutes the sole option of maximizing the use of Uranium City area manpower. Equipment may be available by contract with Eldorado Nuclear Ltd. or the Department of Northern Saskatchewan, if not the private sector.

The use of wood chips or such other organic materials as peat would have to be seen as an impractical means of surface stabilization, due to the non-availability of such materials on the Crackingstone Peninsula and the cost of hauling such bulk from the Uranium City area plus the equipment mobilization cost.

The only other, potentially viable, alternative to using rip-rap would be found in the utilization of chemicals as surface stabilization agents, perhaps

in conjunction with a form of snowfencing. Two promising chemical agents with different effects are Terrasol and Uresol. Both may be used in conjunction with seed and fertilizer application, utilizing hydroseeding techniques and equipment. Indeed, their utility is given only in conjunction with seeding, fertilizing, and possible mulching. Promising quick revegetation of the windblown tailings, the use of these chemicals nevertheless requires the hauling of bulk materials and equipment from southern Saskatchewan. This haul would be quite costly and the entire operation would involve a minimum of Uranium City manpower.

Once the difficulty of surface stabilization is overcome, it will be relatively easy, by comparison, to deal with fertilization and seed selection questions in the ultimate revegetation of the Gunnar Main Tailings. The 1982 review of the 1981 experimental work indicates that very important queries have been answered in the conduct of the experiments.

APPENDIX

Field Observation Details

1. Fertilization Plots (south to north; surrounding areas used for control)

F58 - A1 (fast release: 20-20-20)

- vegetation cover:

young fescue	30% approx.
mature fescue	15% approx.
foxtail barley	25% approx.
bare area	30% approx.

- foxtail barley height approximately 10 inches in the plot, much the same as in the surrounding area

- density and colour of new (fescue) growth more pronounced in the plot than in the surrounding area

- no apparent density, colour, and vigour differentiation between mature fescue growth within and outside the plot

F58 - A2 (slow release: 18-6-12)

- vegetation cover:

young fescue	10% approx.
mature fescue	50% approx.
foxtail barley	5% approx.
bare area	35% approx.

- foxtail barley growth in the plot much the same as in the surrounding area

- colour and vigour of new (fescue) growth more pronounced and evident in the plot than in the surrounding area

- mature fescue height approximately 28 inches in the plot, about one-third taller than in the surrounding area; pronounced differentiation also in density, colour, and vigour

F58 - B1 (fast release: 20-20-20)

- vegetation cover:

young fescue	50% approx.
mature fescue	20% approx.
foxtail barley	10% approx.
bare area	20% approx.

- foxtail barley height approximately 10 inches in the plot, much the same as in the surrounding area

- density (in particular) and colour of new (fescue) growth more pronounced in the plot than in the surrounding area

- no apparent density, colour and vigour differentiation between mature fescue growth within and outside the plot, with a height of approximately 20 inches.

F58 - B2 (slow release: 18-6-12)

- vegetation cover:

young fescue	10% approx.
mature fescue	30% approx.
foxtail barley	10% approx.
common plantain	3 plants
arrow grass	2 clumps
bare area	50% approx.

- foxtail barley height approximately 12 inches in the plot, much the same as in the surrounding area

- density and colour of new (fescue) growth slightly more pronounced in the plot than in the surrounding area

- mature fescue growth in the plot approximately 18 inches high, much the same as in the surrounding area; but rather pronounced differentiation in density, colour, and vigour

F52 - A2 (fast release: 20-20-20)

- vegetation cover:

young fescue	15% approx.
mature fescue	5% approx.
foxtail barley	10% approx.
bare area	70% approx.

- foxtail barley height approximately 10 inches in the plot, much the same as in the surrounding area

- density and colour of new (fescue) growth more pronounced in the plot than in the surrounding area

- mature fescue growth approximately 18 inches high in the plot, much the same as in the surrounding area

F52 - A1 (slow release: 18-6-12)

- vegetation cover:

young fescue	0% approx.
mature fescue	5% approx.
foxtail barley	50% approx.
bare area	45% approx.

- foxtail barley height approximately 18 inches and colour much more pronounced in the plot than in the surrounding area with a height of approximately 10-12 inches

- new (fescue) growth non-existent in the plot and scarce in the surrounding area

- mature fescue growth scarce in the plot and in the surrounding area

F48 - A2 (fast release: 20-20-20)

- vegetation cover:

young fescue	0% approx.
mature fescue	25% approx.
foxtail barley	0% approx.
bare area	75% approx.

- no foxtail barley in the area

- new (fescue) growth virtually absent in the area

- mature fescue growth approximately 24 inches high in the plot, as opposed to the surrounding area with a mature fescue height of approximately 18 inches; density in the plot much more pronounced than in the surrounding area with 5% approx.

F48 - A1 (slow release: 18-6-12)

- vegetation cover:

young fescue	5% approx.
mature fescue	90% approx.
Foxtail barley	5% approx.
bare area	0% approx.

- foxtail barley growth in the plot much the same as in the surrounding area

- new (fescue) growth in the plot much the same as in the surrounding area

- mature fescue growth, including density and colour, much more pronounced in the plot with a height of approximately 28 inches than in the surrounding area at a density of 5% approximately and with a height of approximately 15 inches

F43 - A1 & A2 (slow release: 18-6-12; both according to tags)

- vegetation cover:

young fescue	5% approx.
mature fescue	80% approx.
foxtail barley	5% approx.
bare area	10% approx.

- foxtail barley evident in the plot but not in the immediate surrounding area, though much the same as in the larger surrounding area

- new (fescue) growth much the same in the plot as in the surrounding area

- mature fescue growth much more pronounced in density and colour in the plot, with a height of approximately 28 inches, than in the surrounding area at 5% approximately and a height of approximately 18 inches

F43 - B1 (fast release: 202-20-20)

- vegetation cover:

young fescue	5% approx.
mature fescue	40% approx.
foxtail barley	10% approx.
daisies	25% approx.
bare area	20% approx.

- foxtail barley growth much the same in the plot as in the surrounding area, with a height of approximately 12 inches for both

- new (fescue) growth much the same in the plot as in the surrounding area

- mature fescue growth more pronounced in the plot, with a height of approximately 18 inches, than in the surrounding area at a density of 15% approximately and a height of approximately 15 inches

- daisy invasion equally heavy in the plot and the surrounding area

F43 - B2 (slow release: 18-6-12)

- vegetation cover:

young fescue	10% approx.
mature fescue	80% approx.
foxtail barley	5% approx.
daisies	3 plants
bare area	5% (heavily thatched)

- foxtail barley growth more pronounced in the plot, with better colour and a neight of approximately 15 inches, than in the surrounding area with a height of approximately 12 inches

- young (fescue) growth in the plot much the same as in the surrounding area, but heavy thatch at ground level

- mature fescue growth much more pronounced in the plot, in density, colour, and with a height of approximately 26 inches, than in the surrounding area at 5% approximately with a height of approximately 18 inches

- daisy invasion slight in the plot, but heavy in the surrounding area at 35% approximately

2. Replicate Treatment Areas (north to south)

R2 - C (plots near northern end of tailings, into tree stumps)

- generally, no evidence of seeding or establishment

- no evidence of super phosphate fertilization impact

- negligible, if any, lasting impact of fast release fertilization

- height, colour and density of mature native fescue in the slow release fertilization plots (still containing fertilizer) rather more pronounced at 80% approximate than in the surrounding area at 5% approximate

- density, colour and height (for foxtail barley only) somewhat more pronounced in the slow release fertilization plots for young (fescue) and foxtail barley growth at a density of 10% approximate each, than in the surrounding area at a density of 5% approximate each

R2 - B (plots near tailings embankment)

- some evidence of seeded red top and red fescue establishment and survival, despite windblown tailings accumulation

- no evidence of super phosphate fertilization impact

- negligible, if any, lasting impact of fast release fertilization

- slow release fertilization impact most discernible with native foxtail barley, showing good colour at a height of approximately 18 inches

R2 - A (plots near tailings embankment)

- some evidence of seeded red fescue establishment and survival, despite windblown tailings accumulation

- four plots show superior (to surrounding area) growth of native vegetation with fertilization of unknown type, though plots are buried by windblown tailings and the plants are smothered by tailings sand

R1 - A (westernmost, nearest water)

- one good plot of seeded red top, set seed

- mature native red fescue enhanced by fertilizer of unknown type in same plot

R1 - B (plots nearest location of origin for hummock transplants)

- plots overblown by tailings sand

- no survival of seeded grasses if established

- no evidence of fertilization impact on native vegetation

R1 - C (south-easternmost plot location)

- same observations as for R1 - B.

3. Foxtail Barley Transplant Locations

Extending the slurry pipeline from the mill as a line separating the Main Tailings, as per attached map.

- all transplants north of the line appear dead

- all nine transplants (indicated on the map by X X X) in the row immediately south of the line contained one live stalk per hummock

- all six transplants (indicated by XX) in the second row south of the line contained one live stalk per hummock

- all six transplants (indicated by $\overset{X}{X}$) immediately south of the actual slurry pipeline along the embankment appear dead

- all three transplants (indicated by X) in the third row south of the line appear dead

- all three transplants (indicated by X) in the fourth row south of the line appear dead

- one transplant in the fifth row south of the line (indicated by X) appear dead; one hummock contained four live stalks; and one hummock contained two live stalks

- fifth row conditions repeated in the sixth row south of the line

- in the seventh row south of the line, moving east to west, conditions were as follows:

  easternmost X, one hummock appeared dead; the remaining two hummocks each contained three live stalks

  next X moving west, one hummock (No. 53) appeared dead; the remaining two hummocks each contained four live stalks

  second to last X moving west, all three hummocks appeared dead

  westernmost X, one hummock not identified; last two hummocks alive with multiple stalks, but not as healthy as non-transplanted hummocks in the surrounding (pick-up) area.

Map Locations of experimental areas on Gunnar Main tailings.